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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/US91/01871 (22) International Filing Date: 22 March 1991 (22.03.91) (30) Priority data: 501,829 30 March 1990 (30.03.90) US (71) Applicant: OWENS-CORNING FIBERGLAS CORPORATION [US/US]; Fiberglas Tower - T/26, Toledo, OH 43659 (US). (72) Inventors: ADZIMA, Leonard, Joseph ; 40 Faneuil Hall Road, Pickerington, OH 43147 (US). HAGER, Thomas, Paul ; 197 Sassafras Way, Westerville, OH 43081 (US). FLAUTT, Martin, Charles ; 230 Knoll Drive, Granville, OH 43023 (US).		(74) Agents: PACELLA, Patrick, P. et al.; Fiberglas Tower - T/26, Toledo, OH 43659 (US). (81) Designated States: AU, BE (European patent), BR, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), IT (European patent), JP, KR, NL (European patent), NO, SE (European patent). Published <i>With international search report.</i>
(54) Title: COATING COMPOSITION FOR FIBERS (57) Abstract An aqueous coating composition for fibers comprising a thermoplastic polymer powder, a surfactant, a film former polymer, a thickening agent, the balance being water. When coated onto a bundle or strand of glass fibers the coated glass fibers have a final solids content range from about 25 - 30 weight percent and have good flexibility and good compressive strength. Optical fibers are wrapped with coated continuous filaments and then coated with an extruded layer of a thermoplastic resin.		

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DESCRIPTION**COATING COMPOSITION FOR FIBERS**TECHNICAL FIELD

15 This invention relates to impregnant or coating compositions for fibers. The coating compositions of the present invention are especially useful for coating continuous glass strands for use as an overwrap on a fiber optical cable.

20

BACKGROUND ART

 The use of coating compositions on fibers is well known and coating compositions are applied to the surface of the fibers for several reasons. While coating compositions are usually applied to the fibers for the purpose of protecting the fibers during processing
25 subsequent to their formation, such compositions can also have incorporated into their compositions certain components which impart properties which facilitate their usage. Such properties which can be improved include impact strength, compressive strength, strand integrity, flexibility, toughness, and improved adherence
30 between the fiber and a matrix resin.

 Such coated fiber are useful in overcoating or wrapping fibers or cables such as, for example, optical cables. Typically, glass fibers are used as an overwrap on a cable or fiber and a thermoplastic resin is solidified on the glass fibers typically by an extruded overcoat.
35 There is no adhesion between the extruded jacket and the braided, helically wound or otherwise applied overwrap. While installing a

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5 cable, grips are attached to the ends of the cable. Due to the poor
adhesion between the braided glass overwrap and the extruded
coating the grips tend to pull the extruded coating off the cable. The
use of the thermoplastic impregnated strands, according to the
present invention, prevents this by adhering to the extruded overcoat.

10 An object of the present invention is to provide a slurry or
coating composition for coating glass fibers useful as an overwrap or
coating on cables or fibers. It is a further object to provide a coating
composition which does not suffer the drawbacks of conventionally
15 coated fibers. In cables currently produced special members are
required to prevent buckling. These members are expensive and
difficult to use. The thermoplastic impregnated overwrap of the
present invention becomes the anti-buckling member after it is fused.
It is still a further object to provide a coating composition which can
20 be totally bound to an extruded protective coating which typically
surrounds the cable or fiber.

DISCLOSURE OF INVENTION

The present invention provides an aqueous coating composition
25 useful for glass strands which comprises a thermoplastic resinous
dispersion with a film forming polymer.

The coating of the present invention comprises: a thermoplastic
resin (preferably polyethylene polymer powder), a surfactant, a film
forming polymer (preferably a polyurethane latex polymer), a gel or
thickening agent, the balance being water.
30

According to one preferred use of the present invention, the
thermoplastic resin polymer is suspended in the aqueous coating
composition in the powdered form when coated on a bundle or strand
of fibers or filaments. The coated strand is then wrapped around a
cable or core. After the cable or core has been wrapped with the
35 strand, a thermoplastic jacket is extruded over the top of the cable
or core. The heat of the molten polymer causes the thermoplastic

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5 polymer powder in the overwrap to melt and flow. The strand can also be preheated prior to the extrusion of the thermoplastic jacket to provide a more complete fusion of the powdered polymer on the overwrap. Upon cooling, the wrapped cable stiffens imparting anti-buckling and stiffness to the cable without adding a separate stiffness member.

10 The present invention achieves a desirable cable without the need to use self crosslinking resinous materials to provide partial curing or to reduce tackiness of the coating. The present invention further does not require the use of any lubricants.

15 The aqueous coating composition is especially useful in impregnating continuous glass strands in conventional in-line or off-line coating processes.

20 These and other aspects and advantages of the present invention will become more clear after consideration is given to the detailed description of the invention which follows.

BEST MODE OF CARRYING OUT INVENTION

25 The present invention is employable with any glass fiber conventionally utilized for the reinforcement of polymeric resins. The term "glass fibers" as used herein shall mean filaments formed by attenuation of one or more streams of molten glass and to strands formed when such glass fiber filaments are gathered together in forming. The term shall also mean yarns and cords formed by applying and/or twisting a multiplicity of strands together and to
30 woven and non-woven fabrics which are formed of such glass fiber strands, yarns, or cords. Preferably, the coating formulation of the present invention is usable with conventionally available fibers.

35 The glass fibers used as input to an off-line process can be sized with any conventionally known sizing composition, which is well known to those skilled in the art.

The individual components utilized in the practice of this invention are commercially available and can thus be simply blended

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5 with one another in the preparation of the formulations embodying the features of the present invention.

The invention comprises an aqueous coating composition comprising, approximately, on a weight percent basis:

	Weight percent
10 thermoplastic polymer powder	5 - 50
surfactant	.5 - 1.5
film former polymer	.5 - 5
a thickening agent	0 - .1
water	balance

15 Final solids content ranges from 6 to 56 weight percent. The coating composition is applied so as to deposit a dried coating on the fibers corresponding to about 5 to 50 weight percent of the weight of the fibers (LOI).

20 Preferably the aqueous coating composition comprising, approximately, on a weight percent basis:

	Weight percent
thermoplastic polymer powder	18 - 24
surfactant	.75 - 1.0
film former polymer	1 - 3
25 a thickening agent	0 - .05
water	balance

30 Final solids content ranges from 20 to 28 weight percent. The coating composition is applied so as to deposit a dried coating on the fibers corresponding to about 24 to 30 weight percent of the weight of the fibers (LOI).

35 The thermoplastic resin used in the aqueous coating composition may be selected from among conventional thermoplastic resin powders such as, for example, polyesters, polyethylenes, polypropylenes, polyamides and other such conventional polymers available in a powdered form. The particle size of these powdered polymers should be less than 100 microns. One such material is a

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5 polyethylene polymer, Microthene FN 510 R available from USI
Chemicals Co. In a preferred embodiment the average particle size
of the thermoplastic powder is in the range of about 20 microns or
less. It is desired that the resins useful for coating cables (especially
optical fibers) have good impact strength, a high modulus of
10 elasticity, good flexibility, and good adhesion to polyethylene and
PVC jacketing materials.

The surfactant used in the aqueous coating composition may be
a conventional polyether polyol, such as, for example an alkyl aryl
polyether alcohol sold by the trade name TRITON X 100 R available
15 from the Rohm & Haas Co.

The dispersible or emulsifiable film forming polymer used in
the aqueous coating composition may be a conventional elastomeric
polyurethane polymer, such as, for example, RUCO 2010 L available
from the RUCO Polymer Corp.

20 The gel or thickening agent used in the aqueous coating
composition may be chosen from a wide range of conventional
thickening agents. Drewfloc 270, a polyamide from Drew Chemical
Co., has been found to be particularly useful in this application.

The amount of water in the aqueous coating composition is that
25 amount necessary to give a total solids (nonaqueous) content of the
aqueous coating composition sufficient to coat the fibers. It is
preferred to have the total solids content in the range of about 5 to
50 weight percent, most preferably about 20-28 weight percent.

In the preferred method of formulation of the aqueous coating
composition, the surfactant is dissolved in about three fourths of the
30 water forming a main mixture. The thermoplastic resin powder is
dispersed into the main mixture. The film forming polymer is then
added directly to the resulting main mixture. The thickening agent is
dissolved in the remaining water, and thereafter added to the main
mixture. The resulting aqueous coating composition has a good
35 consistency, low viscosity, and good stability.

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5 The aqueous coating composition can be applied to continuous strand glass fibers in conventional off-line or in-line processes. In the in-line process the coating is applied as a sizing in the fiber forming operation. In the off-line process a bundle of input strands of glass fibers are pulled through an impregnation bath comprising the aqueous coating composition. The excess coating composition is removed by a stripper die. The resulting wet impregnated or coated bundle is dried in a conventional manner. The coated glass strands may be dried at elevated temperatures in an oven by any of the processes known to those skilled in the art to remove a substantial amount of the water. They may also be dried using a dielectric oven. 15 The drying of the coated glass strand at elevated temperatures does not melt or fuse the thermoplastic resin. The thermoplastic resin is held to the glass fiber by the film forming polymer.

In one process a package is formed by taking up the dry or nearly dry strand on a winder. The package typically has a 5-20 percent by weight residual moisture. Further moisture is then removed by oven drying the package. The oven temperature must be below the melting point of the powdered polymer. The resultant coated strand is plyable and has excellent powder holding capability. 20

25 The coated glass fiber is especially useful as an overwrap on any type of cable, or on a fiber optic cable. It is also within the contemplated scope of the present invention that the coated glass fiber can be used in any of a number of reinforcement products. The coated glass fiber is overwrapped on a cable or fiber in a manner known to those skilled in the art.

30 A glass fiber coated with the aqueous coating composition of the present invention is superior to the conventionally coated or otherwise sized fibers currently available since the coated glass fibers have a desirably higher loading content of thermoplastic resin powder. The glass strand, as coated, is flexible, and is as easily processed as conventionally sized glass fibers. 35

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5 It is also within the contemplated scope of the present
invention that such overwrapped cable have a secondary coating or be
further coated with an extrusion of some type of thermoplastic resin
such that the thermoplastic resin on the glass fibers not only fuses
together with itself, but also is totally bound with the secondary
10 thermoplastic coat. This then provides a coated glass fiber which
behaves both as a tension member and as a compression member. As
a compression member the glass fiber overwrap on the cable serves
as an antibuckling element to prevent damage to the core fiber or
cable during processing, installation or in-use curing temperature
15 cycling, especially cold temperature exposures (-40°C).

INDUSTRIAL APPLICABILITY

EXAMPLE 1

20 An inventive coating composition prepared from the following
ingredients:

	percent	Weight
25	thermoplastic polymer powder, Microthene FN 510 from USI Chemicals Co.	25
	alkyl aryl polyether alcohol surfactant TRITON X100 from Rohm & Haas	0.89
	polyurethane latex film forming polymer RUCO 2010 L from RUCO Polymer Corp.	2.0
30	poly acrylamide thickening agent, Drewfloc 270 from Drew Chemical Co.	.048
	water	balance

35 Final solids content was about 27 weight percent. The coating
composition is applied onto a conventionally sized glass, here an H-15
762 sized glass available from Owens-Corning Fiberglas Corporation

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5 so as to deposit a dried coating on the fibers corresponding to about 26 weight percent of the weight of the fibers (LOI).

Heating the coated fibers to about 150°C causes the adhered thermoplastic resin to flow and fuse, thereby producing a fiber reinforced product especially suitable for use as a coating or overwrap for a cable or fiber. The coated, cured fiber reinforced
10 product when overwrapped on a cable provides a cable having the necessary flexibility and proper degree of stiffness for subsequent processing.

The fiber reinforced optical fiber or cable can have a secondary coating comprising, for example a thermoplastic resinous material
15 which further protects the optical fiber. In a preferred embodiment the thermoplastic resinous material of the secondary coating is essentially the same thermoplastic resinous material used in the aqueous coating composition.

20 While the invention has been described in detail and with reference to specific embodiment thereof, it will be apparent to one skilled in the art that various changes and modification can be made therein without departing from the spirit and scope thereof.

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10 CLAIMS

1. An aqueous coating and impregnant composition consisting essentially of, on a weight percent basis:

		Weight percent
	thermoplastic polymer powder	5 - 50
15	surfactant	.5 - 1.5
	film former polymer	.5 - 5
	a thickening agent	0 - .1
	water	balance

20 2. The aqueous coating composition of claim 1 having a final solids content ranging from 6 to 56 weight percent.

3. An aqueous coating and impregnant composition consisting essentially of, on a weight percent basis:

		Weight percent
25	thermoplastic polymer powder	18 - 24
	surfactant	.75 - 1.0
	film former polymer	1 - 3
	a thickening agent	0 - .05
30	water	balance

4. The aqueous coating composition of claim 3 having a final solids content ranging from 20 - 28 weight percent.

35 5. An aqueous coating and impregnant composition consisting essentially of, on a weight percent basis:

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5		Weight percent
	thermoplastic polymer powder	25
	surfactant	0.89
	film former polymer	2.0
	a thickening agent	.048
10	water	balance

6. The aqueous coating composition of claim 5 having a final solids content of about 27 weight percent.

15 7. A plurality of flexible filaments at least a portion of the filament's surface being coated with a residue produced by evaporating water from the aqueous coating composition of claim 1.

20 8. A filament according to claim 7 wherein the filament is made of glass.

25 9. A wrapped optical glass fiber comprising a layer of a reinforcing material substantially covering an optical glass fiber, the reinforcing material comprises continuous filaments coated with a residue produced by evaporating water from the aqueous coating composition of claim 1.

30 10. The optical glass fiber of claim 9 wherein the wrapped fiber has coated thereon an extruded layer of a thermoplastic resin material.

35 11. The optical glass fiber of claim 10 wherein the extruded layer of thermoplastic resin material is essentially the same thermoplastic resin as the thermoplastic polymer powder in the aqueous coating composition.

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5 12. The aqueous coating composition according to claim 1
wherein the thermoplastic polymer is a polyethylene polymer in the
powdered form.

10 13. The aqueous coating composition according to claim 1
wherein the surfactant is an aryl alkyl polyether alcohol.

14. The aqueous coating composition according to claim 1
wherein the film former polymer is a polyurethane latex polymer.

15 15. The aqueous coating composition according to claim 1
wherein the thickening agent is a polyacrylamide.

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INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/01871

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: C 03 C 25/02; C 08 J 5/08, G 02 B 6/44														
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; border-bottom: 1px solid black;">Classification System</td> <td style="border-bottom: 1px solid black;">Classification Symbols</td> </tr> <tr> <td style="height: 40px; vertical-align: bottom;">IPC5</td> <td style="vertical-align: bottom;">C 03 C; C 08 J; C 08 L; C 09 D; G 02 B</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched⁸</div>			Classification System	Classification Symbols	IPC5	C 03 C; C 08 J; C 08 L; C 09 D; G 02 B								
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IPC5	C 03 C; C 08 J; C 08 L; C 09 D; G 02 B													
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category¹</th> <th style="width: 70%; border-bottom: 1px solid black;">Citation of Document¹¹ with indication, where appropriate, of the relevant passages¹²</th> <th style="width: 20%; border-bottom: 1px solid black;">Relevant to Claim No.¹³</th> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="vertical-align: top;">EP, A1, 0062138 (CHEMISCHE WERKE HÜLS AG) 13 October 1982, see the whole document --</td> <td style="vertical-align: top; text-align: center;">1-6, 12-15</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="vertical-align: top;">DE, B2, 2024477 (PPG INDUSTRIES, INC.) 26 October 1978, see the whole document --</td> <td style="vertical-align: top; text-align: center;">1-8, 12-15</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td style="vertical-align: top;">Patent Abstracts of Japan, Vol 10, No 28, C326, abstract of JP 60-180938, publ 1985-09-14 (FURUKAWA DENKI KOGYO K.K.) -- -----</td> <td style="vertical-align: top; text-align: center;">9-11</td> </tr> </table>			Category ¹	Citation of Document ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	A	EP, A1, 0062138 (CHEMISCHE WERKE HÜLS AG) 13 October 1982, see the whole document --	1-6, 12-15	A	DE, B2, 2024477 (PPG INDUSTRIES, INC.) 26 October 1978, see the whole document --	1-8, 12-15	A	Patent Abstracts of Japan, Vol 10, No 28, C326, abstract of JP 60-180938, publ 1985-09-14 (FURUKAWA DENKI KOGYO K.K.) -- -----	9-11
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents:¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 50%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>														
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border-bottom: 1px solid black;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="height: 40px; vertical-align: bottom;">20th June 1991</td> <td style="vertical-align: bottom; text-align: center;">17. 07. 91</td> </tr> <tr> <td style="border-bottom: 1px solid black;">International Searching Authority</td> <td style="border-bottom: 1px solid black;">Signature of Authorized Officer</td> </tr> <tr> <td style="text-align: center; height: 40px;">EUROPEAN PATENT OFFICE</td> <td style="vertical-align: bottom;"> <div style="border: 1px solid black; display: inline-block; padding: 2px 5px;">M. PEIS</div> M. Peis </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	20th June 1991	17. 07. 91	International Searching Authority	Signature of Authorized Officer	EUROPEAN PATENT OFFICE	<div style="border: 1px solid black; display: inline-block; padding: 2px 5px;">M. PEIS</div> M. Peis				
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EUROPEAN PATENT OFFICE	<div style="border: 1px solid black; display: inline-block; padding: 2px 5px;">M. PEIS</div> M. Peis													

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/US 91/01871**

SA 46096

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 30/04/91
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A1- 0062138	13/10/82	DE-A- 3111902	07/10/82
DE-B2- 2024477	26/10/78	BE-A- 750649	20/11/70
		FR-A-B- 2044805	26/02/71
		GB-A- 1286725	23/08/72
		NL-A- 7006976	24/11/70
		SE-B- 359808	10/09/73
		US-A- 3655353	11/04/72
		US-A- 3814715	04/06/74

For more details about this annex : see Official Journal of the European patent Office, No. 12/82